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(54) **Scraper with wear-resistant coating**

(57) A scraper or blade (1) intended, for instance, for cleaning or creping purposes, comprises a thin, flexible steel strip 1 having a work surface (4) provided with a thin surface coating (5) of a material having higher wear-resistance than the steel strip. The wear-resistant material may be, ceramic material, metal oxides or metal carbides, for example.

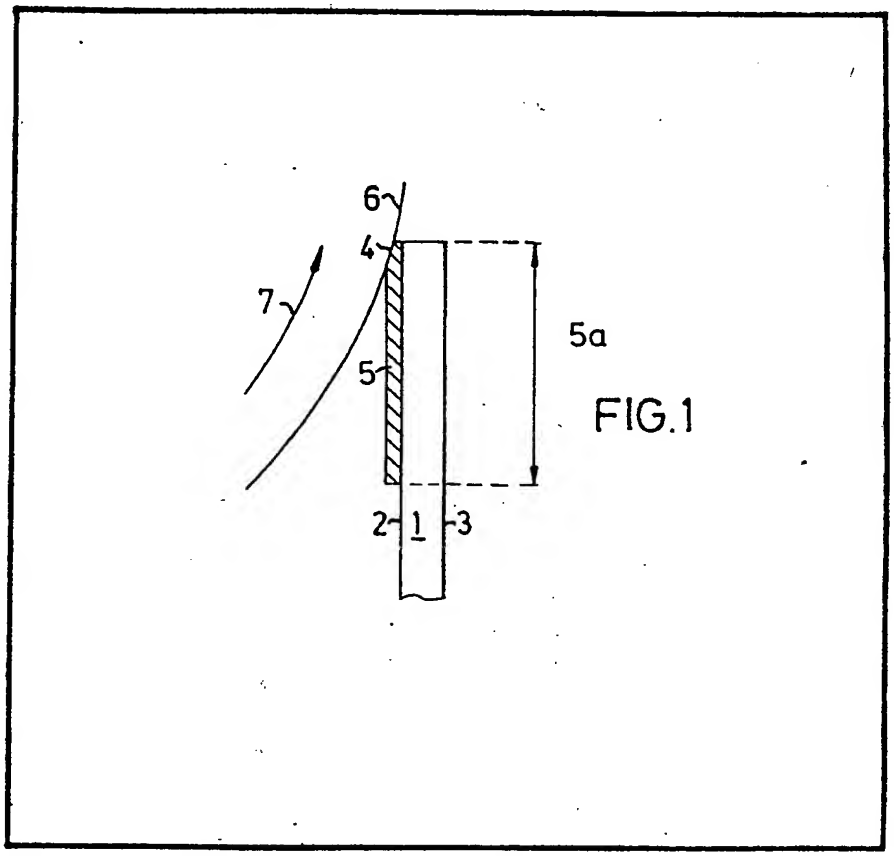

FIG.1

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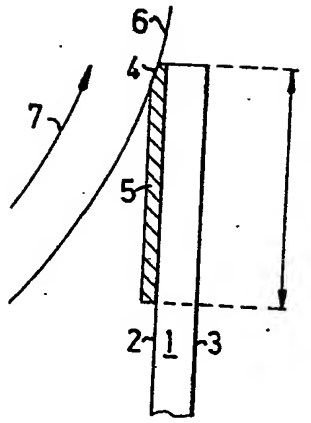

FIG.1

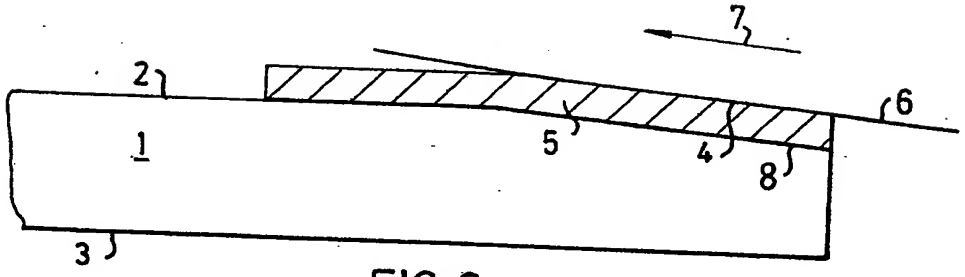

FIG.2

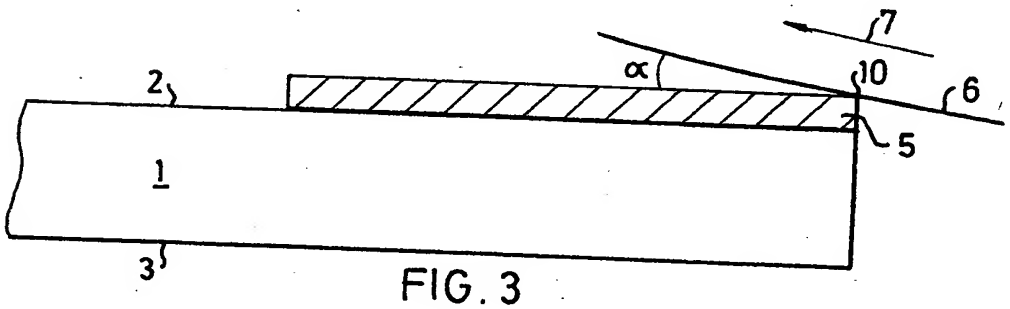

FIG.3

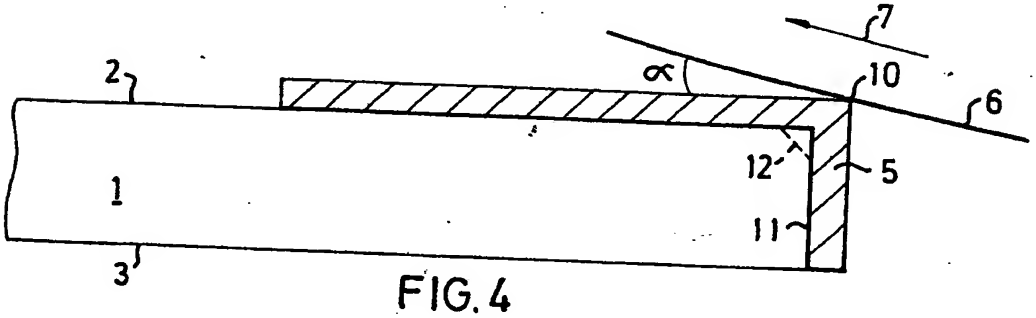

FIG.4

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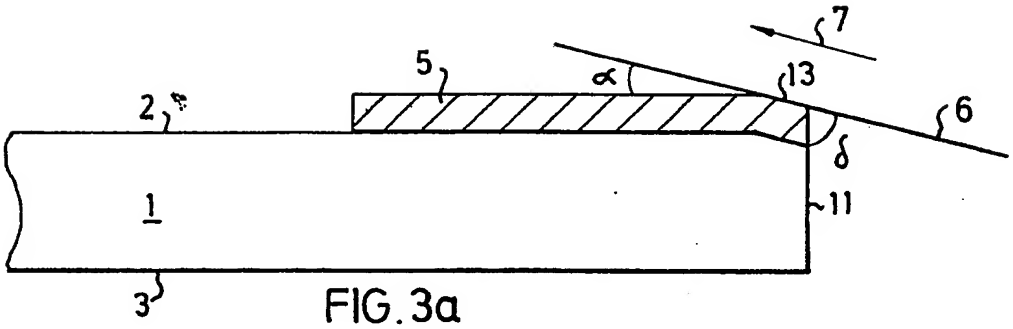

FIG.3a

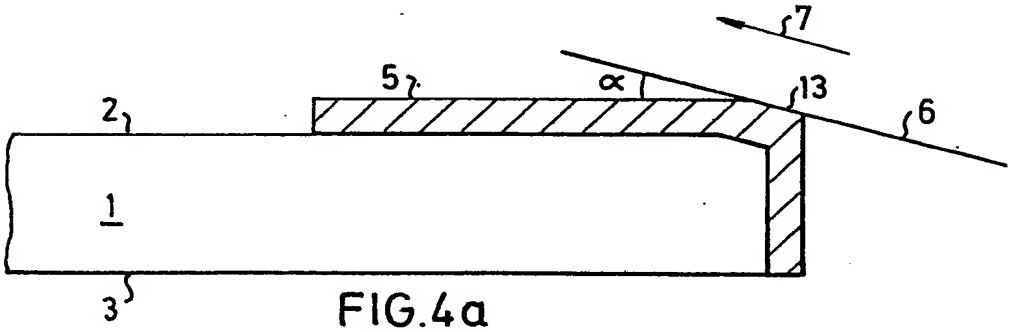

FIG.4a

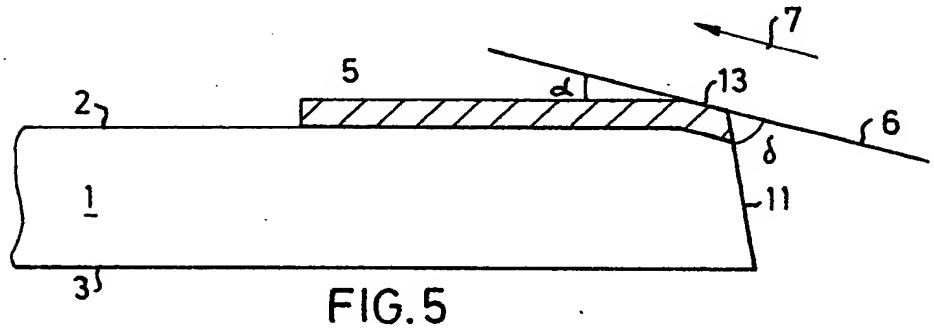

FIG.5

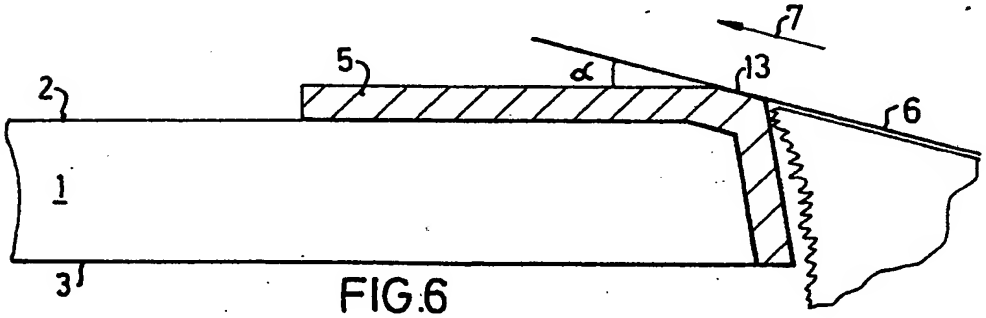

FIG.6

SPECIFICATION

Scraper

The present invention relates to a scraper or blade for use in direct contact with a metallic roller or drum. Such scrapers and blades are herein, and in the claims, referred to alike as scrapers. Such scrapers are used, for example, for scraping clean printing rollers and inkers or for creping paper.

For such purposes conventional blades or scrapers have the drawback that they are subjected to relatively quick, and sometimes extremely uneven wear, and must therefore be replaced after only a short time in use.

A great deal of work has been put into endeavours to increase the service life of conventional coating blades and scrapers and the properties of the traditional blade or scraper have been optimised by appropriate choice of steel composition and by treatments such as annealing.

It might also be possible to increase the service life of a coating blade, scraper or the like by using a material which in itself is more wear-resistant than the conventional spring-steel. However, more wear-resistant materials, such as hard metals and cermets, are not always sufficiently flexible. Indeed such materials are generally extremely brittle and would therefore break easily due to the stresses normally occurring from time to time in a scraper of the kind specified.

Attempts have previously been made to solve the wear problems by attaching pieces of strips of more wear-resistant material to a flexible scraper of steel or the like. Hard chromium plating or plating of the scraper with some other material has also been suggested to give the inherently soft carrier material a better wear surface. These known solutions are difficult to implement, however, particularly with thin scraper blades. It has been found, for instance, that the desirable properties of the basic material of such a scraper, such as flexibility, necessary for good coating results, were considerably detracted from by such attempts to solve the problem of wear. It is, of course, essential for the adoption of any scraper having a longer service life than conventional scrapers that it should still give a perfectly satisfactory result in use.

It is an object of the invention to provide a scraper with a long service life, which also provides satisfactory results in use.

According to the invention, there is provided a scraper suitable for use in direct contact with a metallic roller or drum, the scraper comprising a flexible steel strip of which an operative work surface, extending to an edge of the strip, is provided with a thin surface coating of a material having a higher wear-resistance than steel.

The application of a relatively thin, durable, surface coating on only a small part of the carrier material enables the carrier material to retain the necessary flexibility and other initial properties. The risk of cracks is minimised due to the extremely thin coating. The scraper can have the same mechanical properties, e.g. flexibility, as a traditional scraper, enabling the scraper to be used in conventional holders for retention and pressure already provided in existing equipment.

Embodiments of the invention are described below, by way of example with reference to the accompanying drawings, in which:

Figures 1 to 6 are schematic sectional views showing respective scrapers or blades embodying the invention.

The blades or scrapers shown in the drawings can be used, for instance, to scrape clean printing rollers or inkers, drying cylinders for paper or fabric and the like, or as scrapers for creping paper.

Referring to Figure 1, a scraper, the operative end of which only is shown, comprises a strip 1 of carrier material. The opposite major surfaces 2 and 3 of the strip 1 are parallel faces in the embodiment shown. The reference 6 denotes a schematically intimated roller, such as an engraving roller for intaglio printing, rotating in the direction of arrow 7. The blade engages the roller 6 adjacent a free edge of the blade and the part, nearest the region engagement with the roller, of the flat face 2 of the strip 1 facing the roller 6 is coated with a thin coating 5 of a material having higher wear-resistance than the material of the strip 1, which in this example may be of a flexible spring steel strip 0.05 to 0.15 mm thick and 15 mm wide. The blade surface facing towards the roller has, adjacent said free edge, a bevel surface 4 which in use abuts the surface of the engraving roller 6 to scrape off excess ink. The coating 5, in this embodiment, is applied directly on the flat surface 2 of the strip 1. The flat surface 2 is also considered as the entry side of the scraper and the coating 5 is arranged in a coating zone 5*a*, the width of this zone along the entry side 2 being preferably slight in relation to the width of the scraper. In the embodiment of Fig. 1 this width is at most 5 mm.

Figure 2, in which like references to those in Figure 1 denote like parts, shows a variant scraper for use in cleaning an inker 6 rotating against the scraper in the sense shown by arrow 7. In this arrangement the steel strip 1 is formed with a bevel surface 8 extending from the major planar surface 2 to the free edge of the blade and the wear-resistant coating 5 on the entry side 2 extends over the bevel surface 8 in the carrier material.

Figures 3—6 show four other embodiments each in the form of a scraper for creping a paper web. In these figures, like references again denote like parts, reference 6 denoting the paper supporting drum and reference 7 indicating the direction of rotation.

In Figures 3 and 4, an edge 10 of the coating 5 formed where an upper surface of coating 5, parallel with face 2 meets an edge face of coating 5, parallel with, or continuous with the free edge face of the strip 1, is used as the work "surface" of the scraper. In Fig. 4 the coating 5 has also been applied over the free edge face 11 of the

carrier material of strip 1, in order to increase the durability of the edge 10. Even greater strength can be achieved by providing the strip 1 with a bevelled surface 12 extending to its free edge from surface 2 before the coating is applied, as shown by broken lines in Fig. 4. and subsequently applying the coating to extend over bevel surface 12. In a further variant, not shown, both sides of the strip 1 are coated adjacent the free edges of the strip and thus the scraper provides two equivalent edges so that when one edge has become worn, the scraper can be turned and the other edge brought into operation.

In Fig. 3 the angle between the upper surface of the scraper and roller surface at the point of contact, is designated α.

Figs. 3*a* and 4*a* show embodiments in which the operative surface of the scraper, which engages the drum 6, consists of a narrow bevel surface 13 extending from the upper surface, parallel with the face 2, of the coating, to the end face of the coating or the coating/strip combination. The embodiments according to Figs. 3 and 4 are otherwise equivalent to those shown in Figs. 3*a* and 4*a*.

In Fig. 3*a* the angle between the free edge face of the scraper and the part of the drum surface immediately upstream of the scraper, which is the angle of application, is denoted by δ.

The embodiments according to Figs. 5 and 6 are equivalent to those in Figs. 3*a* and 4*a* with the exception that the angle of application δ is smaller in Figs. 5 and 6 and the free edge face of the blade is inclined at an obtuse angle to the upper planar face 2 of the strip 1.

The carrier material for the scraper, i.e. the strip 1, in the above embodiments, preferably consists of a cold-rolled, toughened, spring-steel strip having a thickness of 0.15—2.0 mm or even thinner. The maximum thickness of the coating proposed is dependent on the thickness of the carrier material but normally, should not exceed 0.35 mm. The coating is built up by applying a plurality of thin layers, one on top of the other by spraying of the molten coating material, each said thin layer having a thickness of 0.002—0.045 mm, for instance. The total thickness of the coating is preferably not more than 50% of the thickness of the carrier material for scraper materials up to 0.40 mm in thickness, 40% for carrier materials of 0.40 mm to 0.90 mm in thickness, 30% for carrier materials of 0.90 to 1.20 mm in thickness and 25% for carrier materials of 1.20 to 2.0 mm in thickness.

The technique used to apply the coating is thermal spraying in which a molten coating material is sprayed against the surface to be coated. In the present case plasma or flame spraying are suitable methods. With plasma-spraying, preferable in many cases, a gas is heated so intensely by an arc that the gas achieves plasma state. In this plasma state the gas is sprayed from a nozzle in a jet and the material to be used for coating is supplied to the plasma jet in powder form by a carrier gas. The powder thus melts immediately and is thrown by the jet in molten state onto the surface to be coated. To avoid heat-damage on the often extremely thin steel blade being coated, the coating, very thin in itself, is built up in steps.

The wear-resistant material used in the coating according to the invention may consist of ceramic material, cermets, a metal or oxides or a metal carbides or carbides or combination of one or more of these. However, the coating material most suitable for each specific purpose may have to be selected taking into account the field of application in question. Although certain coating materials, such as chromium oxide, for instance, offer good wear-resistance, it has been noted that such a coating may have drawbacks for some types of application.

Surprisingly, coatings consisting primarily of alumina have proved to be particularly suitable and particularly good results have been achieved using coatings of alumina (Al_2O_3) with a small quantity of some other metal oxide, such as titanium oxide (TiO_2).

The following experiments with blades or scrapers manufactured in accordance with the invention confirm the desired improvement over conventional scrapers achieved.

Experiment 1

A scraper 0.150 mm thick, with a wear-resistant coating of alumina and titanium oxide 0.050 mm thick and similar to the scraper of Figure 1, was used for scraping clean an intaglio cylinder used for gravure printing.

The service life of the blade was more than tripled in comparison with conventional intaglio blades and a fully equivalent result was achieved.

Experiment 2

A creping scraper such as described with reference to Fig. 6, having a wear-resistant coating of alumina was used to manufacture creped tissue in a Yankee machine. The scraper carrier material, of spring steel, was 1.2 mm thick, and the scraper had a wear-resistant coating 5 which was 10 mm wide and 0.200 mm thick. The width of the strip 1, measured across the width of the paper web, i.e. along the length of the blade, was 3 m and its speed of travel relative to the drum 6 was 900 m/min. The scraper, inserted in the scraper holder of the paper machine, produced a perfectly satisfactory creping result for over 10 hours.

When creping with conventional creping scrapers of the same material and thickness, but without a wear-resistant coating, the conventional scraper must be replaced after less than an hour because the bevel surface becomes so worn that creping is coarse and uneven. The time needed to change the conventional scraper was three minutes, resulting in a production loss of 5%. 5% production loss in a typical plant corresponds to 800 ton paper/year.

When building up the surface coating, before the first layer of coating material is applied, the

carrier material in the zone to be coated should be subjected to a suitable preparatory surface treatment, such as careful blasting with carborundum, preferably immediately prior to application of said first layer. In some cases the application of a layer of binder of nickel alloy or the like may be advisable between the pre-treated surface of the carrier material and the first layer of the coating.

Successive thin layers of coating material are then applied one on top of the other in such a way that the original flexibility and uniformity of the carrier material is not noticeably affected.

The width 5*a* of the coating zone should be at most 20 mm, preferably less than 10 mm.

In a further embodiment of the present invention the scraper or blade can be provided with such a wear-resistant coating on opposite planer surfaces of the strip 1 so that the scraper has an upper harder layer of said wear-resistant coating, an intermediate layer consisting of the uncoated carrier material and a lower harder layer of said wear-resistant coating. In such a case, the carrier material may be exposed at the free edge face of the blade so that said edge face has marginal portions, providing working surfaces or edges, of said coating material, and an intermediate portion of the carrier material.

The blade or scraper proposed according to the invention, with the wear-resistant coating applied, has substantially the same mechanical properties, including flexibility, as the original uncoated steel blade, and a perfectly satisfactory scraping result is thus guaranteed. Good flexibility and minimum brittleness in the coating itself are achieved by the proposed stepwise building up of the very thin surface coating.

Claims

1. A scraper suitable for use in direct contact with a metallic roller or drum, the scraper comprising a flexible steel strip of which an operative work surface, extending to an edge of the strip, is provided with a thin surface coating of a material having a higher wear-resistance than steel.

2. A scraper according to claim 1 wherein said coating comprises ceramic material.

3. A scraper according to claim 1 wherein said coating comprises at least one metal oxide.

4. A scraper according to claim 1 wherein said coating comprises at least one metal carbide.

5. A scraper according to any one of claims 1 to 4, in which said strip has a thickness of 2.0 mm or less and the wear resistant coating has a total thickness of, at most, 0.35 mm.

6. A scraper according to any preceding claim, in which said coating has been formed by depositing, by spraying molten wear-resistant material, a plurality of relatively thin layers of said material one on top of the other, in succession.

7. A scraper according to any preceding claim, in which said strip comprises two opposite major surfaces and said work surface is provided by a bevelled portion of one of said major surfaces, extending to said edge of the strip, and in which the total work surface of the scraper is provided by said coating.

8. A scraper according to claim 7, in which the steel strip has itself a bevelled edge portion upon which said coating of wear resistant material providing said work surface, is deposited.

9. A scraper according to any preceding claim in which said strip has a first surface on which a part of said coating providing said work surface is deposited, and has a second, edge surface meeting said first surface at a substantial angle, and wherein the coating of wear-resistant material extends over at least the portion of said second surface adjoining the first surface.

10. A scraper according to claim 9, in which the work surface provided by said coating, and the surface of the coating over said edge face, meet at an obtuse angle.

11. A scraper according to claim 9 or claim 10, in which the portions of the steel strip on which the coating is deposited include a major surface, an edge surface and a bevelled surface connecting said major surface and said edge surface and inclined relative to both, and wherein said coating extends over said bevelled surface and over at least the adjoining portions of said major surface and said edge surface.

12. A scraper according to any preceding claim in which the coating consists primarily of alumina.

13. A scraper according to claim 12, in which the coating consists of alumina (Al_2O_3) with a small quantity of another metal oxide.

14. A scraper according to claim 13 wherein said other metal oxide is titanium oxide (TiO_2).

15. A scraper according to claim 14, wherein the coating contains 97% Al_2O_3 and 3% TiO_2.

16. A scraper according to any preceding claim, in which the zone over which the coating extends has a width of at most 20 mm.

17. A scraper according to claim 16, wherein said coating has a width of less than 10 mm.

18. A scraper substantially as hereinbefore described with reference to and as shown in Figure 1 of the accompanying drawings.

19. A scraper substantially as hereinbefore described with reference to and as shown in Figure 2 of the accompanying drawings.

20. A scraper substantially as hereinbefore described with reference to and as shown in Figure 3 of the accompanying drawings.

21. A scraper substantially as hereinbefore described with reference to and as shown in Figure 4 of the accompanying drawings.

22. A scraper substantially as hereinbefore described with reference to and as shown in Figure 3*a* of the accompanying drawings.

23. A scraper substantially as hereinbefore described with reference to and as shown in Figure 4*a* of the accompanying drawings.

24. A scraper substantially as hereinbefore described with reference to and as shown in Figure 5 of the accompanying drawings.

25. A scraper substantially as hereinbefore

described with reference to and as shown in Figure 6 of the accompanying drawings.

26. Any novel feature or combination of features described herein.

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